**Ala Wai Flood Risk Management GR Study - Management Measure Tracking Spreadsheet**

*last updated: March 31, 2022*

| Tracking # | Measure Name | Location | Description | Status | Notes/Rationale |
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| 1 | Flap gates on storm drains | Ala Wai Blvd. between Kalakaua and Ala Moana Blvd. | During high tide Ala Wai Blvd. between Kalakaua and the cul de sac ending at Ala Moana Blvd. floods. Ala Wai canal in this area needs flap gates to keep Ala Wai Canal water from flooding storm drains and flooding streets. | Under consideration | Provision, modification, and/or maintenance of drainage systems to capture and convey interior runoff in urban areas is a non-Federal responsibility and therefore cannot be included in a recommendation made as a result of this general reevaluation report. However, this study can make modifications to natural stream channels or previously modified natural waterways that help reduce backup within adjacent drainage systems. |
| 2 | Elevate canal walls | Ala Wai Canal | Increase canal capacity by elevating the existing canal floodwalls | Under consideration | |
| 3 | Deepen the canal | Ala Wai Canal | Excavate to deepen the existing canal and stabilize existing floodwalls. | Screened Out | Dredging to the maintenance elevation is encouraged for the City to maintain consistently. Deepening the canal further than the maintenance elevation is generally not recommended due to the stability of canal walls and slope stability. Increasing storage of the canal can technically reduce flooding but not without instability of the structural components of the bridges and canal walls. The integrity of the canal walls as-is would not withstand excavation - only replacing with an entirely new system would. Further analysis is needed to determine the stability of bridge pier and footings. See measure 5. |
| 4 | Deepen canal for periodic pump drainage | Ala Wai Canal | Dig existing walls deeper to turn the canal into a periodic pump drainage to address inundation by all three sources of flooding | Screened Out | Digging the existing walls deeper is not recommended due to their strucutral integrity. Pumping the canal to increase storage capacity is not recomended due to stability of the existing canal walls. Hydrostatic pressure is likely needed for structural stability. Technical analysis needed to determine structural stability of bridge piers and footings. See measure 5. |
| 5 | Deepen the canal, replace canal walls with higher flood protection | Ala Wai Canal | Dredge canal down to its original depth of 15' to 25', and replace the degraded infrastructure with new canal walls that are set for greater flood protection | Under consideration | The integrity of the canal walls as-is would not withstand greater dredging efforts than maintence dredging - only replacing with an entirely new system would. Further analysis is needed to determine the appropriate wall height, the stability of bridge pier and footings, and the optimal depth that balances slope stability and flood storage. |
| 6 | Widen canal | Ala Wai Canal | Widen the canal to provide greater flow and storage capacity. | Under consideration | Widening the canal in strategic locations, namely at the Eastern end of the canal, could provide more flood storage. Further analysis is needed. Widening the canal for the entire length would require extensive real estate acquisitions with significant costs. Expanding canal storage through the use of floodwalls and/or utilizing existing storage areas along the canal (e.g., golf course, Ala Wai Community Park) are likely more efficient and are considered elsewhere. |
| 7 | Dredge Ala Wai Canal to original depth | Ala Wai Canal | Dredge canal down to its original depth of 15' to 25' since current dredging only goes down to 12'. | Screened Out | Dredging to the maintenance elevation is encouraged for the City to maintain consistently. Deepening the canal further than the maintenance elevation is generally not recommended due to the stability of canal walls and slope stability. Increasing storage of the canal can technically reduce flooding but not without instability of the structural components of the bridges and canal walls. The integrity of the canal walls as-is would not withstand excavation - only replacing with an entirely new system would. Further analysis is needed to determine the stability of bridge pier and footings. See measure 5. |
| 8 | Dredge Manoa-Palolo | Manoa-Palolo Channel | Dredge the Manoa-Palolo channel | Under consideration | |
| 9 | Canal clean ups | Ala Wai Canal | Involve the community to conduct regular clean ups | Screened Out | Organizing clean-ups is outside the scope of the current study. Community involvement for clean ups after construction is a possibility; however, those initiatives those initiatives need to be initiated by other entities. |
| 10 | Effective Microorganisms (EM) to eliminate sludge | Ala Wai Canal | Use "genki balls" to clean up and eliminate sludge in the canal. These healthy microorganisms work to digest sludge in the canal which will help not only to evacuate water from the canal quicker, but also restore the ecosystem and reduce frequency for dredging. | Screened Out | Sludge eliminated by the genki balls would have to be extensive enough to reduce flood risk in order to be justified under the current study. Genki balls would eliminate the organic matter within the canal, which only makes up a small portion of material within the canal. Genki balls as a standalone measure would not provide enough reduction in material to increase storage capacity of the canal and reduce flood waters. Genki balls could be incorporated into a separate effort focused on ecosystem restoration. |
| 11 | Oysters to clean the canal | Ala Wai Canal | Use oysters as filters to clean the canal waters. | Screened Out | Improving water quality is outside the scope of this project. |
| 12 | Debris management | Watershed wide | Better manage the debris that ends up in the canal | Under consideration | Debris management will likely be most effective when utilized in conjunction with other measures (e.g., combined storage/debris management basins; structural modifications to bridges). |
| 13 | Submersible pumps | Ala Wai Canal | Use underwater pumps to create a lower profile pumping station | Under consideration | |
| 14 | Miter gates | Ala Wai Canal | Use several smaller radius miter gates to minimize visual impacts (to be used in conjunction with pump station) | Under consideration | |
| 15 | Lowered gate structure | Ala Wai Canal | Use a lowered structure underwater that could be raised in an event instead of a miter dam. (to be used in conjunction with pump station) | Under consideration | |
| 16 | Retractable flood barriers | Ala Wai Canal | Relocate pump station to the golf course. Use a series of retractable flood barriers that would allow for 4 rowing lanes (44' wide) across the width of the canal. | Under consideration | |

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| 17 | Prevent bulky refuse from clogging streams | Watershed wide | Some people experiencing houselessness/homelessness are living near the streams and disposing of large, bulky items there. Discarded items include air conditioners, refrigerators, carpets and clothing; these block the canal and prevent water and debris from flowing freely down the stream. Locations identified: Woodlawn Bridge, Dole Street Bridge, Lower Waahila Ridge, Kanewai Park, St. Louis Heights Bridge, Kapiolani behind Service Station, Kaimuki High School, Date St, etc. | Screened Out | Managing houselessness/homelessness is outside the scope of the USACE feasibility authority; however, debris management can be included within the design of other project features, see #12. |
| 18 | Pump via conduits | Ala Wai Canal | Pump flood waters via pipes, conduits or microtunnels to harbor instead of using high walls | Under consideration | |
| 19 | Change canal floor slope | | Change the floor slope of the canal to push water out quicker; excavate to 25' deep at the Ala Moana bridge | Under consideration | Dredging to the maintenance elevation is encouraged for the City to maintain consistently. Deepening the canal further than the maintenance elevation is generally not recommended due to the stability of canal walls and slope stability. The integrity of the canal walls as-is would not withstand excavation - only replacing with an entirely new system would. However, dreding at strategic locations, as opposed to the entire canal, can be investigated. Further analysis is needed to determine the stability of bridge pier and footings. Further analysis also needed to determine the sensitivity of the canal slope to reducing flood elevations during a storm event. |
| 20 | Microtunnel through Waikiki | Ala Wai Canal & Waikiki | Several microtunnels along the canal (i.e. under Paoakalani Ave, Ohua Ave, Liliuokalani Ave, Kanekapolei St, Nohonani St, Lewers St, Kalaimoku St, etc.), going under Waikiki and straight out to the ocean to increase conveyance | Under consideration | |
| 21 | 2nd outlet on east end of canal (open canal) | Ala Wai Canal | Open up the east end of the canal with an open system extending down Paki Ave and makai through Kapiolani Park | Under consideration - Tier 2 | Minimizing property acquisitions would help greatly in keeping costs down. Likely to have significant water quality and environmental effects. Identified as a Tier 2 measure for modeling purposes. Modeling of storage features needs to occur prior to modeling this measure in order to assess an accurate water volume. |
| 22 | 2nd outlet on east end of canal (underground) | Ala Wai Canal | Extend the canal underground with a box culvert running beneath Paki Ave down Kapahulu Ave. or Monsarratt Ave. | Under consideration - Tier 2 | See note on measure 21. |
| 23 | East canal buried pipe system | Ala Wai Canal | Put a buried pipe system with a two way pump on the east end of the canal. During storms the pump can evacuate water from the canal or as regular maintenance the pump can reverse to bring fresh sea water to help circulate the canal. 30 cfs of seawater can accomplish both reduced sedimentation and improved water quality. | Under consideration | |
| 24 | Tunnel for additional outlet through Waikiki | Ala Wai Canal & Waikiki | Tunnel under Waikiki at Fort Derussy or through an underground pipe starting at the MP-canal confluence and shooting straight out to sea. | Under consideration | |
| 25 | Underwater pipes in canal | Ala Wai Canal | Use underwater pipes laid on the floor of the canal to redirect floodwaters directly to the harbor. These pipes could redirect flows directly from Makiki or the Manoa-Palolo straight out to sea without entering the Ala Wai canal. | Under consideration | |
| 26 | Canal sluice gates | Ala Wai Canal | Design sluice gates to account for storm surge and high tides to prevent backflow through manhole covers | Screened Out | Sluice gates specifically to address coastal flooding is outside the scope of this study; however, flap gates to prevent backflow from elevated water surfaces within the canal has been identified as a separate measure, see #1. |
| 27 | Floodwalls on Waikiki side of canal only | Ala Wai Canal | Build floodwalls only on the Waikiki side of the canal. Do not build floodwalls on the Moiliili side of the canal. | Screened Out | Placing floodwalls on only one side of the canal could induce damages on the other side. This study seeks to reduce flood risk for all areas in a cost-effective and environmentally conscious way. Therefore, measures seeking to implement floodwalls adjacent to the canal would consider both sides. Floodwalls are considered a Tier 2 measure for modeling purposes. Modeling of storage features needs to occur prior to modeling this measure in order to assess an accurate water volume. |
| 28 | Submersible pump & gate at canal mouth | Ala Wai Canal | Submersible pumps and floodgate at Ala Moana Bridge. Excavate entire canal to 25' deep from Kapahulu to harbor. Pre-pump canal ahead of a storm. Smaller submerged pumps at Manoa confluence to push water towards harbor. Build a dam under McCully and/or Kalakaua bridges with pump station. | Under consideration | Pumping the canal ahead of a storm to max capacity is not recomended due to stability of the existing canal walls. Hydrostatic pressure is likely needed for structural stability. Technical analysis needed to determine structural stability of bridge piers if dredged to 25' deep. |
| 29 | Mauka canal floodwall | Ala Wai Canal - Mauka Side | Raise mauka canal wall so it is the same height as the Waikiki wall. This floodwall would need to extend past Iolani School up to the Date St. bridge | Under consideration | See notes on measure #2. |
| 30 | Pump & Gate at canal mouth | Ala Wai Canal at Ala Moana Bridge | Pump and gate at Ala Moana Bridge. Pre-pump to drain canal ahead of a storm for additional storage capacity. Pump gates can hold back storm surge up the canal, as well as facilitate pump down and out of the canal against high tide conditions. A pump gate can also ease the cleaning/dredging of the canal without using dredge (use bulldozer instead with drained canal). | Screened Out | Pumping the canal ahead of a storm to max capacity is not recomended due to stability of the existing canal walls. Hydrostatic pressure is likely needed for structural stability. Pump and gate as a standalone measure, as to not drain the canal ahead of a storm, will be carried forward for further consideration. Measure under further consideration is #196. |

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| 31 | Dam at canal mouth | Ala Wai Canal at Ala Moana Bridge | Replace high wall ideas on either side of the Ala Wai canal with a dam at the end of the canal where it exits by Ala Moana Blvd. (at the narrow opening after Ala Moana Blvd between the Waikiki Yacht Club and the Prince Waikiki Hotel). Force the water to exit from the Ala Wai water channel but not enter from the ocean into the Ala Wai canal. Secondly, water from high rain days could be diverted with above ground pipes away from the Ala Wai canal. | Screened Out | A dam at the mouth of the canal near the harbor would need considerably higher canal walls for greater storage and a pump system. The intent of this measure is captured under #196. |
| 32 | Retention or Detention pond | Ala Wai Community Park | Implement retention or detention pond or a constructed wetland at Ala Wai Community Park. | Under consideration - Tier 1 | Identified as a priority for modeling. Potential uses for park will be considered after initial hydraulic modeling. |
| 33 | Redesign of Ala Wai Community Park | Ala Wai Community Park | Redesign the Ala Wai Community Park into a flood park with wetlands and taro patches. Redesign areas of the park for community access and visitor education. | Under consideration | |
| 34 | Detention basin for mauka drainage storage | Ala Wai Community Park | There are a number of drainage system outfalls that either run through the Ala Wai Community Park or along its perimeter (drainage systems coming down Isenberg or University for example). Reengineer the baseball fields to use as detention basins serving these drainage systems. Perhaps rerouting the section of shared use path that runs along the canal to the mauka side of the baseball fields and double as a berm. | Under consideration - Tier 1 | See measure 32. |
| 35 | Pump station on golf course | Ala Wai Golf Course | Put pump station on the Ala Wai golf course if one is needed. | Under consideration | |
| 36 | Underground pump station | Ala Wai Golf Course | Build pump station partially underground for less visual impact. | Under consideration | |
| 37 | Octopus Plan | Ala Wai Golf Course | Put pump station on the Ala Wai golf course and pipe the intakes from critical locations and outtakes directly to the harbor. | Under consideration | |
| 38 | Golf course debris basin | Ala Wai Golf Course | Create a debris basin at the golf course as a first flush before entering the canal | Under consideration | |
| 39 | Golf course detention basin - excavation | Ala Wai Golf Course | Excavate the golf course to increase storage capacity | Under consideration - Tier 1 | Identified as a priority for modeling. Modeling of the golf course area will seek to identify the optimal solution, including how/where to divert water from, extent of additional storage needed to reduce flood risk, and potential for application of natural and nature-based measures either as stand-alone measures or in conjunction with structural components. |
| 40 | Golf course detention basin - berms | Ala Wai Golf Course | Utilize the entire golf course with higher berms for increased storage capacity | Under consideration - Tier 1 | See notes for measure 39. |
| 41 | Golf course wetlands | Ala Wai Golf Course | Convert the golf course to wetlands. See Bea Aglibot's "A Unified Landscape: Reconnecting the Ala Wai Watershed to Ancient Waikīkī" which can be found here on ScholarSpace: https://scholarspace.manoa.hawaii.edu/handle/10125/55834 | Under consideration | See notes for measure 39. |
| 42 | Manoa-Palolo reroute through golf course | Ala Wai Golf Course | Divert the Manoa-Palolo into the golf course; construct golf course as a wetland with native plants to clean the water before exiting into the canal. | Under consideration | See notes for measure 39. |
| 43 | Ala Wai Canal flow through system | Ala Wai Golf Course | Reroute the Manoa-Palolo from Date St. into the golf course, with an open or closed channel along the north and east boundaries of the golf course, connecting to the east end of the Ala Wai canal. This will help flush and circulate the east end of the canal, also reducing the health risk of bacteria | Under consideration | See notes for measure 39. |
| 44 | Divert floodwaters to golf course | Ala Wai Golf Course | Intercept the floodwaters upstream and divert them to the golf course for storage | Under consideration | See notes for measure 39. |
| 45 | Golf course underground parking structure | Ala Wai Golf Course | Create an underground parking structure at the golf course that connects to Waikiki and can be used as flood storage. | Under consideration | |
| 46 | Create a community park | Ala Wai Golf Course | Turn the golf course into a flood park that's usable for the community ("Ala Wai Park") or reinvent it as a cultural park that doubles as a detention basin. | Under consideration | See notes for measure 39 regarding use of golf course as a detention basin. |
| 47 | Excavate and rearrange golf course | Ala Wai Golf Course | Excavate mauka side of golf course to accept mauka surface run-off and use that side as a driving range and run-off detention basin. Put a 12' wall on makai side and pump station built to transfer water from it to a much larger golf course detention basin with a 12' wall around it. | Under consideration | See notes for measure 39. |
| 48 | Delta at Manoa-Palolo confluence with wetlands | Ala Wai Golf Course and Ala Wai Canal/ Manoa-Palolo Confluence | Turn Ala Wai golf course into a lagoon park (Ala Wai Lagoon Park) to absorb storm surges. Construct a delta at the junction of Manoa-Palolo and the Ala Wai Canal for silt and debris capture. This would function to filter stream debris before entering the canal and the golf course would act as a sponge to absorb storm surge and flooding. | Under consideration | See notes for measure 39. Debris basin also captured under measure 38. |
| 49 | Install silt dams | All Streams | Build silt dams in all accessible gullies. The silt dam is composed of local rock from the immediate stream bed, encased in wire fencing. The rushing water is slowed as it goes through the dam, the gravel and dirt drop out behind the dam, the water has more time to penetrate subsoil and rock - replenishing the fresh water lens. | Under consideration | |

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| 50 | Series of silt berm/dams | All Streams | Build a series of low rock (under 6' high) silt berm/dams that direct floodwaters into the natural basin of the valley head. In essence, this creates a relatively dry basin to detain water only during flooding events. The shallow, bowl-like existing topography (with some excavation) could be used as an advantage to allow the waters to spread out and slowly either be absorbed into the water lens or make a more controlled exit into the valley below. Silt dams also use the existing rocks in the valley and avoid bringing in materials from outside. They can hold back some of the soil that normally ends up in the Ala Wai and ocean beyond. This way, the stream beds are unaltered, the water is given room to expand, and provides a more natural way for water to be "guided." The concept is based on the 'auwai of a Hawaiian lo'i, on a much larger scale. | Under consideration | |
| 51 | Stream restoration | Channelized portions of Palolo Stream | Stream restoration opportunities and/or hybrid reintroductions of pool-riffle run stream conditions | Under consideration | |
| 52 | Hausten Ditch conduit | Hausten Ditch | Put a conduit that goes under the Hausten Ditch - the water could flow to the Ala Wai Park detention basins | Under consideration | |
| 53 | Kaimuki High Detention Basin | Kaimuki High School | Utilize Kaimuki High School's football field | Under consideration - Tier 1 | Identified as a priority for modeling |
| 54 | Streamside walking path | Kaimuki High School | Construct a nice streamside walking path adjacent to Kaimuki High School | Screened Out | All measures must be designed to reduce flood risk. A walking path as a stand-alone measure that does not alter flood risk could not be included under the current study authority. However, recreational components can be incorporated into measures that do reduce flood risk (e.g., walking path along elevated berm) and could be considered as a part of those measures. |
| 55 | Subsurface Kanewai Tunnel | Kanewai Community Park | Subsurface tunnel from Kanewai Community Park to the harbor using gravity flow | Under consideration | See measure 57 and 66. |
| 56 | Kanewai detention & bypass conduit | Kanewai Community Park | Detention basin at Kanewai Community Park and a conduit that bypasses Manoa-Palolo and Ala Wai canal. The conduit inlet would begin at the detention basin's low flow outlet. The conduit could be laid either along the stream/canal bed or sides, and the conduit outlet located at the Ala Wai boat harbor, using gravity flow. With conduit located alongside the stream/canal, it can serve as a dual purpose flood barrier (berm) with a raised bike path and sidewalk on top. | Under consideration | See measure 57. |
| 57 | Kanewai Detention basin | Kanewai Community Park | Use Kanewai as a detention basin (preference for underground detention) | Under consideration - Tier 1 | Identified as a priority for modeling. Modeling will consider type and amount of storage needed, where/how to get water to the basin, and where/how to outlet the water (i.e., directly back to channel, conduit to harbor or golf course). |
| 58 | Kanewai bypass to Golf Course | Kanewai Community Park & Ala Wai Golf Course | Intercept the water near Kanewai and pipe or via underground tunnels convey the flood waters to the Ala Wai Golf course so that a detention basin is not needed at Kanewai. | Under consideration | |
| 59 | Kapiolani Park detention basin | Kapiolani Park | Divert water to Kapiolani Park for additional flood storage | Under consideration | |
| 60 | Berm around Iolani and Ala Wai Elementary Schools | Laau St and Hihiwai St. | Put in a berm along Laau St, along Hihiwai St., wrap around the Ala Wai elementary playground (makai direction), and connect to a floodwall along the canal. This would provide protection to Iolani School, Ala Wai Elementary school, and the mauka side neighborhoods (the Manoa-Palolo overtopped in the past). Utilize the green spaces (softball field, dog park, playground) outside the line of protection for additional storage capacity. | Under consideration | |
| 61 | Nature based approach to integrate recreation | Lower Watershed | Use nature based approach that integrates recreation into reserved flood areas (when not flooded). This can enhance this project as a community asset. Maybe tie into Lei of Parks idea (system of paths and bike lanes linking the City's regional and local parks). | Under consideration | Recreational components can be incorporated into a flood risk management plan and can potentially be cost shared with the local sponsor. These opportunities will be pursued as appropriate within this study. |
| 62 | Sponge city | Lower Watershed | Urban development system that absorb, store, infiltrate, and purify rainwater. Examples include interconnected greenways and waterways, contiguous open green spaces, green roofs, porous design interventions and drainage systems, water savings, and recycling initiatives. Look at flood mitigation outside the US such as China, Singapore: https://earth.org/sponge-cities-could-be-the-answer-to-impending-water-crisis-in-china/ or https://www.youtube.com/watch?v=GsBDpp08kwE | Under consideration | |
| 63 | Makiki Stream conduit | Makiki Stream | Put a conduit that goes under the Makiki Stream and divert the water directly out to the harbor | Under consideration - Tier 3 | Considerable infrastructure and cost requirements. Modeling team will initially focus on using existing infrastructure to divert water. |

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| 64 | Modify Makiki Stream entry angle | Makiki Stream and Ala Wai Canal | Modify the angle that the Makiki Stream enters the canal to minimize additional head on the water trying to exit near McCully. The current stream outflow has less than a 90 degree angle, increasing the chance to produce higher water level with backwater during a flood, accumulate sediment, higher cost on channel wall maintainers, etc. | Under consideration | |
| 65 | Forest management | Manoa above Waiakeakua and along Waihi | Manage the forest above Waiakeakua and along Waihi. The forest is changing and becoming increasingly degraded by pigs and invasive plants and trees, thus reducing the resiliency of the watershed to major flooding events. We should look at the watershed as a whole starting at the top where the majority of the rainfall is and the natural systems in place that may be improved to mitigate flooding. | Under consideration - Tier 1 | Modeling will be conducted to quantify the extent to which forest management reduces downstream flood risk at represents a Tier 1 modeling priority. Wildlife management for invasive pigs is outside the USACE authority for this study and cannot be further considered. |
| 66 | SWIFT tunnels | Manoa and Palolo | Two 12' diameter subsurface tunnels (~40' under) from Manoa and Palolo shooting straight out to sea using gravity flow | Under consideration - Tier 3 | The SWIFT tunnels are under further consideration and are a Tier 3 for modeling priority. There are several considerations that the team will investigate including updating costs to include real estate acquisition, preliminary engineering and design, construction management, and inflation, as well as environmental impacts that freshwater will have on the aquatic environment. The technical team will re-evaluate the inlet and outlet structures and determine a comprehensive conceptual design that is a standalone measure, separate from the original design by OCEANIT, which complimented the former USACE design.<br><br>For more information on the original tunnel concept see the November 2020 public meeting presentation video at: https://www.oceanit.com/project/ala-wai/ |
| 67 | Install baffling in streams | Manoa and Palolo Streams | Install baffling in the streams to slow the water down. | Under consideration | |
| 68 | Check dams | Manoa stream | Construct check dams in Manoa to slow the water down ahead of areas prone to flooding | Under consideration | |
| 69 | Kahaloa Bridge widening | Manoa Stream at Kahaloa Bridge | Widen the Kahaloa bridge to allow a larger volume of storm water drainage runoff feeding into Manoa Stream just above the bridge. | Under consideration | |
| 70 | Drop structure | Manoa Stream at Woodlawn Bridge | Install a “falls” just before the bridge at Woodlawn Drive to help push the silt and debris past the bridge to prevent future floods. | Under consideration | |
| 71 | Woodlawn Bridge bypass box culvert | Manoa Stream at Woodlawn Bridge | Create a bypass box culvert that traverses around both bridge abutments and exit into the existing stream channel on the south side of Woodlawn Drive. As an added precaution the catch basin and the drain pipes along Woodlawn Drive number and sizes could be increased. | Under consideration - Tier 1 | Identified as a priority measure for modeling. |
| 72 | Manoa Stream Dredging | Manoa Stream between drainage ditch south of Napuaa Pl. and Kahaloa Dr. (area immediately north of Manoa Valley District Park) | Annually dredging Manoa Stream from where the stormwater drainage ditch feeds into the stream from the Woodlawn Street drainage to the end of the stream area at the end of the Manoa Valley District Park | Under consideration | |
| 73 | Kahaloa Dr. stream modification | Manoa Stream near Kahaloa Dr. | Slow down or reduce the volume of water flowing at Kahaloa Dr. where a stormwater drainage ditch feeds into Manoa Stream. (historically a flood area) | Under consideration | |
| 74 | Kahaloa Ditch entry angle modification | Manoa Stream near Kahaloa Dr. | Modify the angle that the drainage ditch upstream of Kahaloa Drive enters into the Manoa Stream. The sharp 90 degree bend creates a backwater effect inundating the homes surrounding that area. | Under consideration | |
| 75 | Subsurface Manoa Park Tunnel | Manoa Valley District Park | Subsurface tunnel from Manoa Valley District Park to the harbor using gravity flow | Under consideration - Tier 3 | See response to measure 66 |
| 76 | Manoa Park Detention Basin | Manoa Valley District Park | Use Manoa Valley District Park as a detention basin (like Randolph Basin in Tucson) to capture peak flooding above Lowrey Ave and slow release to watershed below. | Under consideration - Tier 1 | Identified as a priority for modeling |
| 77 | SWIFT tunnels with flood gate & pump | Manoa, Palolo, and Ala Wai Canal | SWIFT tunnels in Manoa and Palolo combined with a flood gate and pump at the Ala Moana bridge. Use 100% of the canal for detention. During this time all storm water will be pumped to the ocean via SWIFT or pipes. We can maintain a 0' MSL until the peak flows hit the Ala Wai Canal. Flood gates can be a series of small miter gates in 25-30' sections. Should sea level rise occur we can add a lock system to one of them for recreation passage in the future. | Screened Out | SWIFT tunnels under consideration and are Tier 3 for modeling priority - See response for measure 66. Pumping the canal to 0' MSL is not recomended due to stability of the existing canal walls. System can only be considered if canal walls are replaced due to their degraded integrity. |
| 78 | Upper watershed conduit to Golf Course | Manoa, Palolo, and Ala Wai Golf Course | Intercept flood waters upstream (Manoa and/or Palolo) via pipes, conduits, or microtunnels to the Ala Wai Golf Course detention area. | Under consideration | |

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| 79 | SWIFT tunnels with additional intake and pump | Manoa, Palolo, and McCully | Same as SWIFT Tunnels but with additional intake in McCully utilizing a pump to drain the low-lying area (this would require the Manoa SWIFT tunnel to run directly below McCully) | Under consideration | SWIFT tunnels under consideration and are Tier 3 for modeling priority - See response for measure 66.<br><br>Provision, modification, and/or maintenance of drainage systems to capture and convey interior runoff in urban areas is a non-Federal responsibility and therefore cannot be included in a recommendation made as a result of this general reevaluation report. However, this study can make modifications to natural stream channels or previously modified natural waterways that help reduce backup within adjacent drainage systems.<br><br>Pump can also be justified if additional flow into the system causes induced flooding at McCully. |
| 80 | Add a pump to the storm drainage system in McCully-Moiliili | McCully-Moiliili | Add a pump to the storm drainage system in McCully and other areas that pooling occurs (at the "bottom of the bowl"). | Under consideration | Provision, modification, and/or maintenance of drainage systems to capture and convey interior runoff in urban areas is a non-Federal responsibility and therefore cannot be included in a recommendation made as a result of this general reevaluation report. However, this study can make modifications to natural stream channels or previously modified natural waterways that help reduce backup within adjacent drainage systems.<br><br>Pump can also be justified if additional flow into the system causes induced flooding at McCully. |
| 81 | Divert floodwaters to underground karsts | Moiliili | Divert floodwaters to the existing karsts that run under Moiliili and connect with the ocean. | Screened Out | Very technically challenging due to the unpredictable nature of karst features and the possibility that increased water flows could cause flooding or sinkholes elsewhere. |
| 82 | Natural lined streams | Palolo Stream | Remove the concrete channelization and revert the streams back to its natural state. This will help to slow the water down. | Under consideration | |
| 83 | Taro cultivation at Anuenue | Palolo Stream near Anuenue charter school | Taro cultivation in this area could be expanded. (Potential to slow water down?) | Under consideration | |
| 84 | Mitigate stream bank erosion | Palolo Stream near Keanu St. | Address stream bank erosion on probate properties, caused by upper stream concrete walls increasing stream velocity and creating waterfall effect into dirt stream; stream boulders have redirected storm stream flow into eroding private properties. Stream is owned by Chaminade/Marianist Community and does have funding for equipment and redesigning of flow that has changed over the decades. | Screened Out | Addressing stream bank erosion is generally outside of the USACE authority for flood risk management studies. However, USACE does have other authorities through which stream bank erosion can be addressed (i.e., Section 14 Continuing Authorities Program). |
| 85 | Palolo Park Detention basin | Palolo Valley District Park | Use Palolo Valley District Park for above ground or underground storage. | Under consideration - Tier 2 | Identified as a Tier 2 priority measure for modeling due to high potential for technical challenges as a result of the elevation change between the park and the stream. Adjacent publicly owned land could be used for storage. Additional technical assessment and conceptual designs are required prior to modeling this measure. |
| 86 | Underground detention - parking lots | Parking lots (i.e. Manoa Marketplace) | Excavate beneath existing parking lots to create underground detention basins. | Under consideration | |
| 87 | Underground detention - fields | Parks and green spaces | Excavate beneath existing parks and open green spaces to create underground detention basins | Under consideration | |
| 88 | Manage mountain erosion | Round Top Drive | Additional debris is created by erosion of the mountain sides. The loose debris created by the slides will flow in to the drainage streams during periods of heavy rain and possibly create dams that will flood neighborhoods not identified as high flood risk. | Screened Out | Addressing landslides/erosion is outside of the scope of the USACE study authority; however, debris management may be possible if incorporated within other project features. |
| 89 | Green and Complete Streets | University Ave. | Green and complete streets along University Ave. to provide multi-benefit community improvements including flood water management, vegetation and shade trees, environmental enhancement to support walking, biking, safe access to schools, etc. | Under consideration | |
| 90 | UH practice fields detention basin | University of Hawaii practice fields | Pipe floodwaters to the UH practice fields for additional storage | Under consideration - Tier 3 | This measure is ranked as a Tier 3 measure for modeling purposes due to likely technical challenges and associated costs. Additionally, this area is associated with karst geology, resulting in additional risks. |
| 91 | Remove invasive trees that cause debris | Upper watershed | Remove invasive albizia trees that have shallow roots and branches that break easily, and cause much of the debris and clogged bridges downstream. | Under consideration - Tier 2 | Modeling to assess potential problem areas for debris buildup will be completed first. Specific debris management measures will then be identified. |
| 92 | Remove invasive plants for better groundcover | Upper watershed | Remove invasive plants such as miconia and mule's foot fern that increase runoff and prohibits groundwater absorption. Miconia has a long history of promoting erosion, runoff, and reduces aquifer recharge in the South Pacific. Miconia is considered one of the 100 worst invasive species in the world. Replace invasive species with native plantings that can enhance recharge and reduce runoff. | Under consideration - Tier 1 | Modeling will be conducted to quantify the extent to which forest management reduces downstream flood risk. |

| Tracking # | Measure Name | Location | Description | Status | Notes/Rationale |
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| 93 | Manage feral pigs | Upper watershed | Manage or remove feral pigs that uproot trees and cause erosion and debris downstream. Install pig fencing. | Screened Out | Wildlife management is outside of the USACE study authority. Debris management has been identified as a separate measure, see #12. |
| 94 | Traditional Hawaiian resource management practices | Watershed wide | Utilize traditional Hawaiian resource management practices like loko ia, loi kalo, and fishponds for sediment retention and flood mitigation. | Under consideration | |
| 95 | Increase governmental funding | Watershed wide | Increase funding across local, state, and federal sources to cumulatively work to improve coverage of forest restoration, invasive species control, and other green infrastructure projects. Increase collaboration between government entities. | Screened Out | Increasing funding across local, state, and federal sources is outside the scope of USACE's study authority. |
| 96 | Debris basins | upper watershed | Install debris basins to collect debris in the upper watershed before it clogs up the Ala Wai canal. | Under consideration | This study will consider options to reduce the impact of flooding due to buildup of debris by considering modifications to stream channels and structures such as bridges, as well as measures that address the root causes of debris buildup such as invasive species control, restoration of native plantings, and setbacks. Debris catchment structures will also be evaluated. |
| 97 | Bridge bypass and debris | upper watershed (valleys) | Spot treatment to low spots along the streams - debris screening and emergency bypasses or spillways for each bridge in the valleys so that the waters don't raise and erode neighboring properties. | Under consideration | |
| 98 | Detention basins | upper watershed government lands | Detention basins in government lands in mauka conservation districts if the City will maintain it. There is not enough width and depth in the existing flood channels to accommodate a large flood. | Under consideration | |
| 99 | Reduce waterfront hotels for green pathways | Waikiki | Reduce the number of coastal hotels along Waikiki beach and create green pathways from the Ala Wai and open space where water can flow from mauka to makai. | Screened Out | The study will consider nonstructural measures, such as acquisition and relocation. Relocations must follow standards set forth under the The Uniform Relocation Assistance and Real Property Acquisition Act. Relocation of coastal properties within Waikiki would be very costly, especially with the real estate constraints within the watershed. |
| 100 | Flood zone construction requirements | Waikiki | Require new buildings in Waikiki to be built resilient to floods (e.g. open ground level and permeable surfaces) | Screened Out | Changing local community zoning regulations is outside the scope of USACE's study authority. However, as part of the study USACE can make recommendations related to zoning for local communities to implement. |
| 101 | Storage tunnels | watershed wide | Utilize large, deep vertical tunnels to store stormwater throughout the watershed. | Under consideration | |
| 102 | Diversion tunnels | watershed wide | Construct tunnels that can serve as a dual purpose to convey floodwaters in large storm events and can also be used as transportation (or other utility) infrastructure. | Under consideration | |
| 103 | Replicate Tokyo's water discharge tunnel system | watershed wide | Replicate Tokyo's water discharge tunnel system | Screened Out | A system that mirrors Tokyo's water discharge system (approximately $3B to construct) is likely not to be justified as costs are likely to exceed benefits. |
| 104 | Reduce hardcover and impervious surfaces | Watershed wide | Limit and reduce hardcover in the urban environment that increase runoff. Remove impervious surfaces and replace with porous surfaces. | Under consideration - Tier 1 | Modeling will be conducted to quantify the extent to which decreasing impervious surfaces throughout the watershed reduces downstream flood risk. |
| 105 | Educate homeowners of proper disposal | Watershed wide | Educate homeowners on proper disposal of cuttings and logs | Under consideration | |
| 106 | Educate homeowners of stream maintenance responsibilities | Watershed wide | Educate homeowners who live along the stream of their responsibility to properly maintain the stream within their property | Under consideration | |
| 107 | Increase maintenance funding | Watershed wide | Use the State's portion of what they committed to the project ($120M) towards maintenance and programs to get rid of the causes of debris. | Screened Out | This study will consider options to reduce the impact of flooding due to buildup of debris by considering modifications to stream channels and structures such as bridges, as well as measures that address the root causes of debris buildup such as invasive species control, restoration of native plantings, and setbacks. However, this study will not include long term dredging, maintenance, or periodic stream cleanups as a part of the recommended plan as it is outside of the authority of the Corps to partner in ongoing maintenance efforts. |
| 108 | Replicate Kaori Sanctuary for watershed restoration | Watershed wide | Look to replicating the Karori Sanctuary near Wellington, NZ as a model of a successful watershed restoration project to implement in the Ala Wai watershed ecosystem. The project would involve removing all of the invasive alien species such as the Albizia, the wild pigs, the alien stream species such as the armored catfish, etc. and then replanting with species that are more compatible with the native Hawaiian watershed ecosystem, stabilizing the stream banks with native plants, fencing the entire upper watershed so that the wild pigs once removed from the area cannot re-invade the area, etc. This is the source of the problems that impacts everything else downstream into the canal down into Waikiki. Addressing issues up mauka will mitigate much of the larger issues faced today in the lower watershed. | Under consideration | This study will assess the ability of natural and nature-based measures, including many of those listed here (i.e., non-native species management, watershed management), to reduce downstream flood risk. The team will model and assess the efficacy of these measures using approved technical approaches. However, the study authority is limited with respect to stream bank stabilization (see notes on measure 93) and wildlife management (see notes on measure 84). |
| 109 | Develop a plan for clearing & maintaining the forest and streams | watershed wide | Develop a plan for clearing and maintaining the forest and streams. The plan can include increased frequency of maintenance, and will need to be updated for future conditions. | Under consideration | |
| 110 | Clear overgrown vegetation | watershed wide | Clear the overgrown vegetation from the streams. | Under consideration | Channel clearing and modification can be incorporated into the study; however, USACE would not be engaged in long-term operation and maintenance. |

| Tracking # | Measure Name | Location | Description | Status | Notes/Rationale |
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| 111 | Natural retention areas | watershed wide | Plant trees, mulching areas, large underground retention areas (storage tanks). A way of controlling volume of stormwater. Our current infrastructure is concrete, which doesn't allow for water to naturally percolate into aquifer. Green infrastructure would retain, restore, possibly filter water to a more manageable degree. | Under consideration | |
| 112 | Create wetland terraces | watershed wide | bring the 'aina back to its natural state – bring back the lo'i and flooded wetland terraces, return water to the aquifers | Under consideration | |
| 113 | Put laws in place for water retention | watershed wide | Put laws into place to mandate homeowners retain water on their property for use at a later time, e.g. rain barrels, rain gardens, bioswales. | Screened Out | Changing local community regulations and laws is outside the scope of the USACE study. The study could make recommendations for nonstructural measures, including rain barrels; however, participation would not be mandatory. |
| 114 | Incorporate traditional use and practices | watershed wide | Request for considerations for traditional use and practices to be incorporated within the redesign and improvements of the Ala Wai. For example the retention at the golf course presents an opportunity to reconnect the history of Waikiki and its sprouting fresh water that sustained kalo fields up until the construction of the canal and full-fledged sale of Waikiki to the business interests of large, primarily foreign land owners. Preserve the rights of present and future generations in the waters of the state to include Maoli rights and practices, such as kalo cultivation. | Under consideration | |
| 115 | Establish a Special Drainage and Urban Forest District | watershed wide | The whole urbanized Ala Wai Watershed above the canal needs to explicitly become a part of the solution. The city should establish and landowners should support a "Special Drainage and Urban Forest District", analogous to the Special Districts established in the 1970s for Diamond Head, Waikiki, the State Capitol area, Chinatown, etc. These were established to preserve green open space, views and historic structures. Runoff has substantially increased by added urbanization in the middle reaches the past 100 years. Most recently the situation has been exacerbated by the proliferation of "monster houses" that literally roof and pave most of their property, adding runoff to the storm drains along with other issues. Typically they replaced much smaller houses surrounded by gardens. It seems like "Forest restoration" limited to the mauka conservation zone. | Screened Out | Establishment of such a district is outside the USACE study scope. |
| 116 | Netherlands approach to flood mitigation | watershed wide | Follow approaches done in the Netherlands, using a holistic approach to address flooding. https://www.earthmagazine.org/article/dutch-masters-netherlands-exports-flood-control-expertise/ | Under consideration | |
| 117 | Improve existing stormwater drainage system | watershed wide | Make improvements to the existing stormwater drainage system, such as increasing conduit size or adding additional drainage in areas prone to flooding | Screened Out | Provision, modification, and/or maintenance of drainage systems to capture and convey interior runoff in urban areas is a non-Federal responsibility and therefore cannot be included in a recommendation made as a result of this general reevaluation report. However, this study can make modifications to natural stream channels or previously modified natural waterways that help reduce backup within adjacent drainage systems. This study will also be considering modification of existing storm systems as a means for underground bypass channels. |
| 118 | Bridge modification | watershed wide | Modify by raising or widening bridges that act as choke points, such as the bridges at Woodlawn Drive, Kahaloa, Lowery, East Manoa, and Kapiolani Blvd. | Under consideration | |
| 119 | Convert excess water from liquid to steam | Ala Wai Canal | Change the excess water from liquid to steam by having a small opening in the canal at the height that you don't want the water to go above, and to have this on the Mauka side of the canal. The opening would be small, 2'x2', with a metal grate on the opening like graph paper to prevent fish or other animals from entering and the water would lead to a big stove top like structure with holes in the ground above it leading to the surface to let out the steam. The device would heat up, either automatically by using sensors, or by a switch, so if the water gets too high, the device will heat the water that comes in, turn it to steam, and lower the water in the canal. It would have to be on the Mauka side so the steam can be released without anyone near it so no one gets hurt. | Screened Out | Measure is not technically feasible and poses a safety risk to the community and the environment. |
| 120 | Implement permeable pavement | watershed wide | Replace impervious pavement with permeable pavement on roads throughout the watershed to help with aquifer recharge. | Under consideration | Permeable pavement could present maintenance challenges for the City. The percentage pervious, and related runoff, of the watershed is not expected to change drastically with pervious pavement. Further analysis required. |

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| 121 | Regular maintenance at high risk areas | watershed wide | DFM should be adequately funded to provide full-time dedicated maintenance at all flood risk areas. For example, in Manoa, the Woodlawn Bridge often builds up with debris, plants growing on dirt and "silt bars" as does under the Kahaloa Bridge, despite it being concrete padded several years ago. Also, existing debris catchments such as that behind Palolo Elementary are not well maintained. | Screened Out | A measure related to increasing maintenance is outside the scope of USACE authority. However, there maybe a way to address debris within the design of other project features. |
| 122 | Early flood warning system | watershed wide | Early flood warning system to alert communities of impending floods | Under consideration | |
| 123 | Green space for detention to reduce TMDLs | watershed wide - parks | C&C of Honolulu's Dept of Environmental Services (ENV) has programs in place to reduce TMDLs in critical watersheds to meet stormwater permit conditions with the State Dept of Health/EPA. Consider maximizing the use of available green/park spaces to develop storm water detention/regulation (e.g. when drainage networks are adjacent to parks and can be readily redirected). ENV can work in collaboration with the CORPS for small win-wins. | Under consideration | Detention will be investigated at various green spaces within the watershed. The main purpose, however, is not to reduce TMDLs - it is to reduce flood risk to the community. Detention could inherently result in mutliple benefits. |
| 124 | Loi kalo and ahupuaa system | watershed wide/ Ala Moana Beach Park | consider the Lo'i kalo and ahupuaa system | Under consideration | |
| 125 | Do nothing | watershed-wide | Let it flood and federal government continues to provide funds to assist in clean-up efforts | Under consideration | |
| 126 | Basement parking structure detention | Watershed-wide parking structures | Convert basement parking structures within the watershed into underground detention | Under consideration | |
| 127 | Subsurface Woodlawn Tunnel | Woodlawn Bridge | Subsurface tunnel from Woodlawn Bridge to the harbor using gravity flow | Under consideration - Tier 3 | See measure 66 for a discussion on tunnels |
| 128 | Berm around Innovation Center | Manoa Innovation Center | Build a berm in the parking lot of the Innovation Center to capture overflow waters from Manoa Stream and divert water back into stream downstream of Woodlawn Bridge | Under consideration | |
| 129 | Increase stream capacity | Manoa Stream near Woodlawn Bridge | Widen the stream or build floodwalls to increase stream capacity near the Woodlawn Bridge | Under consideration - Tier 1 | Increasing channel capacity downstream of the bridge could manage flood risk for higher frequency events. This measure is under consideration. |
| 130 | Piikoi Bypass | Piikoi Street from Mo | Utilize existing storm sewer to route water from Kanaha Stream to Ala Moana Park | Under consideration - Tier 2 | This measure is identified as a Tier 2 priority for modeling. Once Tier 1 measures are modeled, there will be a better understanding of the flows that would impact this measure. |
| 131 | Pensacola Bypass | Pensacola St from Ne | Utilize existing storm sewer to route water from Kanaha Stream to Ala Moana Park | Under consideration - Tier 2 | This measure is identified as a Tier 2 priority for modeling. Once Tier 1 measures are modeled, there will be a better understanding of the flows that would impact this measure. |
| 132 | Ke'eaumoku Bypass | Ke'eaumoku Street fr | Utilize existing storm sewer to route water from Kanaha Stream to Ala Moana Park | Under consideration - Tier 2 | This measure is identified as a Tier 2 priority for modeling. Once Tier 1 measures are modeled, there will be a better understanding of the flows that would impact this measure. |
| 133 | Young Bypass | Kaheka Street from Y | Utilize existing storm sewer to route water from Makiki Stream to Ala Wai Harbor | Under consideration - Tier 2 | This measure is identified as a Tier 2 priority for modeling. Once Tier 1 measures are modeled, there will be a better understanding of the flows that would impact this measure. |
| 134 | Makiki Tunnel System | Archie Baker Park to ( | Tunnel System with Storage (can outlet to harbor and/or release with pumps); Inflow from Kanaha at Makiki District Park | Under consideration - Tier 3 | See measure 66 for a discussion on tunnels. |
| 135 | Stevenson Middle School Playing Fields Detention Pond | 1202 Prospect St | Approximately 14 ac-ft of storage near Kanaha Stream headwater | Screened Out | Screened out since measure would provide engineering challenges with the drastic elevation change between the stream and the playing fields. |
| 136 | Roosevelt High School Football Fields Detention Pond | 1120 Nehoa St | Approximately 6 ac-ft of storage near Kanaha Stream headwaters | Screened Out | Screened out since measure would provide engineering challenges with the drastic elevation change between the stream and the playing fields. |
| 137 | Archie Baker Park Detention Pond | 1959 Makiki Heights Dr | Approximately 1 acre of surface; Unsure of depth for storage due to terrain; Near Makiki Stream headwaters | Screened Out | Screened out since measure unlikely to capture significant floodwaters. Additional engineering challenges with the drastic elevation change between the stream and the park. |
| 138 | Makiki District Park and Tennis Courts Detention Pond | 1527 Ke'eaumoku St | Approximately 13 ac-ft of storage at confluence of Kanaha and Makiki Streams | Under consideration - Tier 1 | Identified as a priority for modeling. |
| 139 | Cartwright Neighborhood Park Detention Pond | Lunalilo Street | Approximately 5 ac-ft of storage near Makiki Stream, downstream of confluence with Kanaha | Under consideration - Tier 3 | Identified as a Tier 3 measure. Will consider proximity to streams, inlet/outlet connections, and available storage in the analysis. |
| 140 | Central Union Church Lot Detention Pond | 1660 S Beretania St | Approximately 2.8 ac-ft of storage east of Makiki Stream, downstream of confluence with Kanaha | Screened Out | Screened from consideration since unlikely to be effective due to small storage size and proximity to stream. |
| 141 | Washington Middle School Detention Pond | 1633 S King St | Approximately 1.5 ac-ft of storage east of Makiki Stream, downstream of confluence with Kanaha | Screened Out | Screened from consideration since unlikely to be effective due to small storage size, proximity to the stream, and existing flooding in the vicinity. |
| 142 | Punahou School Detention Pond | 1601 Punahou St | Approximately 22 ac-ft of storage east of confluence with Kanaha and Makiki Stream | Screened Out | Due to location and elevation changes in this area, storage in this location is unlikely to be effective. |
| 143 | Daylight streams | Makiki Stream | Daylight streams at constrictions - will need hydraulic results to identify pinch points | Under consideration | |
| 144 | Ala Moana Park Underground Storage | Ala Moana Regional Park | Underground Storage in conjunction with Bypass measure; storage not expected to be an efficient measure otherwise | Under consideration | |
| 145 | Modify bridges | watershed wide | Modify bridges at constrictions - will need hydraulic results to identify pinch points | Under consideration | |
| 146 | Palolo Channel Modification | Palolo | Deepen channel to provide more within-bank storage; can be used in conjunction with channel naturalization | Under consideration | |

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| 147 | Palolo Channel Naturalization | Palolo | Return channel to a more natural state by removing concrete and adding natural slope material; must be in conjunction with channel deepening, upstream detention and/or bridge modification; this will reduce velocities and dampen peak flow | Under consideration | |
| 148 | Ali'iolani Elementary School Detention Pond | 1240 7th Ave | Approximately 0.7 ac-ft of storage southeast of Palolo Stream | Screened Out | Screened from consideration since unlikely to be effective due to small storage size and proximity to the stream. |
| 149 | William P. Jarrett Middle School Detention Pond | 1903 Palolo Ave | Approximately 0.7 ac-ft of storage near Palolo downstream of the Pukele and Waiomao confluence | Screened Out | Screened from consideration since unlikely to be effective due to small storage size and difference in elevation between the stream and play fields. |
| 150 | Pālolo Valley District Park Detention Pond | 2007 Palolo Ave | Approximately 15 ac-ft of storage near Palolo downstream of the Pukele and Waiomao confluence | Under consideration - Tier 2 | Identified as a Tier 2 priority measure for modeling due to high potential for technical challenges as a result of the elevation change between the park and the stream. Adjacent publicly owned land could be used for storage. Additional technical assessment and conceptual designs are required prior to modeling this measure. |
| 151 | Pālolo Elementary School Detention Pond | 2106 10th Ave | Approximately 0.9 ac-ft of storage near Waiomao just upstream of the Pukele and Waiomao confluence | Screened Out | Screened from consideration since unlikely to be effective due to small storage size and elevation difference between the stream and the playing fields. |
| 152 | Pālolo Valley Homes Detention Pond | 2170 Ahe St | Approximately 6.5 ac-ft of storage near Waiomao just upstream of the Pukele and Waiomao confluence | Screened Out | Screened from consideration due to elevation difference in elevation between the stream and potential storage area. Also potential environmental consideration with extensive removal of trees. |
| 153 | Kula Kaiapuni 'O Ānuenue Detention Pond | 2528 10th Ave | Approximately 0.7 ac-ft of storage near Pukele upstream of the Pukele and Waiomao confluence | Screened Out | Screened from consideration since unlikely to be effective due to small storage size and difference in elevation between the stream and play fields. |
| 154 | Lā-'ī Rd Detention Pond | 4367 Lā-'ī Rd | Approximately 3 ac-ft of storage near headwaters of Pukele | Screened Out | Screened from consideration due to elevation difference in elevation between the stream and potential storage area. Also potential environmental consideration with extensive removal of trees. |
| 155 | Public Storage Parking Lot Detention Pond | 2888 Waialae Ave | Approximately 0.5 ac-ft of storage above the confluence of the Manoa - Palolo Canal | Screened Out | Screened from consideration since unlikely to be effective due to small storage size. |
| 156 | City Mill Parking Lot Detention Pond | 3086 Waialae Ave | Approximately 0.7 ac-ft of storage above the confluence of the Manoa - Palolo Canal | Screened Out | Screened from consideration since unlikely to be effective due to small storage size |
| 157 | Palolo Stilling Basin(s) | Palolo | Stilling Basin to dissipate energy and reduce velocities from channelized stream - will need hydraulic results to identify areas of high velocities with minimal upstream impacts | Under consideration | |
| 158 | Permeable Pavement System at Public Storage Parking Lot | 2888 Waialae Ave | Replace parking lot with permeable pavement to reduce direct runoff above the confluence | Under consideration | See measure 120. |
| 159 | Permeable Pavement System at City Mill Parking Lot | 3086 Waialae Ave | Replace parking lot with permeable pavement to reduce direct runoff above the confluence | Under consideration | See measure 120. |
| 160 | Permeable Pavement System at Pālolo Hongwanji Mission | 1641 Palolo Ave | Replace parking lot with permeable pavement to reduce direct runoff | Under consideration | See measure 120. |
| 161 | Palolo Tunnel System | Palolo Valley District | Tunnel System with Storage (can outlet to ocean using gravity); Inflow from Waiomao and Pukele at confluence (2/3 of system flow); Additional basin inflow does not have ideal entrance location | Under consideration | See measure 66. |
| 162 | Chaminade University Playing Field Underground Storage | 3140 Waialae Ave | Underground detention structure below playing fields of the University; storage capacity not yet determined | Screened Out | Due to location and elevation changes in this area, storage in this location is unlikely to be effective and costs are likely to exceed benefits. |
| 163 | Pālolo Valley District Park Underground Storage | 2007 Palolo Ave | Underground detention structure below park; storage capacity not yet determined | Under consideration | Will be evaluated based on results from measure 150. |
| 164 | Public Storage Parking Lot Underground Storage | 2888 Waialae Ave | Underground detention structure below parking lot; storage capacity not yet determined | Screened Out | Underground detention would not provide significant storage to reduce water surface elevations. Other storage alternatives are still being considered within this watershed. |
| 165 | City Mill Parking Lot Underground Storage | 3086 Waialae Ave | Underground detention structure below parking lot; storage capacity not yet determined | Screened Out | Underground detention would not provide significant storage to reduce water surface elevations. Other storage alternatives are still being considered within this watershed. |
| 166 | Woodlawn Bridge Modification | 2771 Woodlawn Dr | Raise bridge to prevent debris buildup | Under consideration - Tier 1 | Identified as a priority for modeling |
| 167 | Woodlawn Drive Bypass | Woodlawn Drive und | Capture overflow water from Woodlawn Drive and return to stream | Under consideration - Tier 1 | Identified as a priority for modeling |
| 168 | Manoa Channel Modification | Manoa Stream | Deepen/Widen channel to provide more within-bank storage | Under consideration | |
| 169 | Manoa Channel Naturalization at Bridge Highway near E Manoa Rd | 2929 E Manoa Rd | Return channel to a more natural state by removing concrete and bridge highway; replace with natural slope material | Under consideration | |
| 170 | Manoa Channel Naturalization below Manoa Valley District Park | Manoa Valley District | Return channel to a more natural state by removing concrete and adding natural slope material; must be in conjunction with channel deepening, upstream detention and/or floodwalls; this will reduce velocities and dampen peak flow at Woodlawn | Under consideration | |
| 171 | Manoa Channelization | Woodlawn Drive to M | Channelize the stream to reduce peak flows at Woodlawn | Under consideration | This measure will be evaluated; however, channelizing would likely adversely impact natural stream habitat and the study team will seek to minimize environmental impacts. |
| 172 | Manoa Valley District Park Detention Pond | 2721 Kaaipu Ave | Approximately 33.5 ac-ft of storage on the right bank of Manoa Stream | Under consideration - Tier 1 | Identified as a priority for modeling |
| 173 | Kanewai Detention Pond | 2695 Dole St | Approximately 4.5 ac-ft of storage on the right bank of Manoa Stream | Under consideration - Tier 1 | Identified as a priority for modeling |

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| 174 | University of Hawaii Practice Fields Detention Pond | Kalele Rd | Approximately 19 ac-ft of storage on the right bank of Manoa Stream near UH | Under consideration - Tier 3 | See response to measure 90 |
| 175 | Manoa Innovation Center Floodplain/Parking Lot Storage | 2800 Woodlawn Dr | Use natural floodplain/parking lot to contain flood waters and store water | Under consideration - Tier 1 | Identified as a priority for modeling |
| 176 | Woodlawn Bridge Floodwall | 2771 Woodlawn Dr | Floodwall (permanent or deployable) at Woodlawn Drive Bridge vicinity to contain water to channel | Under consideration | |
| 177 | Koali Rd Floodwall | Koali Rd near Kanewa | Floodwall along left bank of Manoa Stream, downstream of Kanewai Community Park to protect community from upstream peak flows | Under consideration | |
| 178 | University of Hawaii Deployable Floodwall | University of Hawaii a | System of deployable floodwall around the UH Campus | Under consideration | |
| 179 | Permeable Pavement System at Manoa Marketplace Parking Lot | 2752 Woodlawn Dr | Replace parking lot with permeable pavement to reduce direct runoff contributing to flows down Woodlawn Drive | Under consideration | See measure 120. |
| 180 | Manoa Tunnel System | Manoa Valley District | Tunnel System with Storage (can outlet to ocean using gravity); detention basin and tunnel from Manoa Valley District Park; approx. 2/3 of flow is in the system at this location; Additional basin inflow does not have ideal entrance location | Under consideration - Tier 3 | See response to measure 66 |
| 181 | Kanewai Underground Storage | 2695 Dole St | Underground detention structure below park; storage capacity not yet determined | Under consideration | |
| 182 | Manoa Marketplace Underground Storage | 2752 Woodlawn Dr | Underground detention structure below parking lot; storage capacity not yet determined | Under consideration | |
| 183 | State Land of Kalaepohaku Ridge Underground Detention | Left Bank of Manoa u | Large underground storage tank on the embankment of the Kalaepohaku Ridge | Screened Out | Real Estate aquisition and engineering challenges to use the base of a mountain side as storage. The team will consider other storage options within this basin. |
| 184 | Physical non-structural measures | Watershed-wide | Nonstructural measures are permanent or contingent measures applied to a structure and/or its contents that prevent or provide resistance to damage from flooding. Measures can include elevation, relocation, acquisition, dry flood proofing, or wet flood proofing. | Under consideration - Tier 1 | Potential for nonstructural measures (e.g., elevation, floodproofing, relocation, flood warning systems) will be assessed once economic models are finalized. |
| 185 | Flood Warning System | Watershed-wide | Flood Warning Systems alert citizens in flood prone areas of impending high water, giving the opportunity to evacuate damageable property and themselves from flood-prone areas. | Under consideration | |
| 186 | Risk Communication/Education | Watershed-wide | Risk Communication develops and uses educational tools such as presentations, workshops, hand-outs, and pamphlets to communicate flood risk and flood risk reduction measures. | Under consideration | |
| 187 | Emergency Preparedness Plans | Watershed-wide | Develop and maintain a flood emergency preparedness plan that identifies hazards, risks and vulnerabilities, and encourages the development of local mitigation. Plans should include the community's response to flooding, location of evacuation centers, evacuation routes, and flood recovery processes. | Under consideration | |
| 188 | Debris Management Plan | Watershed-wide | A comprehensive debris management plan that outlines a strategy to efficiently and effectively remove and dispose of debris on a maintenance schedule or after a storm would reduce blockages at constrictions in rivers and therefore reduce flood levels at those constrictions. | Under consideration | |
| 189 | Ala Wai Canal Tunnel | | Underground tunnel to outlet into the ocean; serves as a second outlet to the canal | Under consideration - Tier 2 | See response to measure 21 |
| 190 | Paki Ave Bypass | | Utilize existing storm sewer system along Paki Ave as a bypass for Ala Wai Canal waters; Outfall is away from the highly traveled beach and tourist area; Existing outfall near Tahitienne Condos of Honolulu | Under consideration - Tier 2 | This measure will be modeled once a more accurate assessment of water flows is determined after Tier 1 measures are modeled. |
| 191 | Leahi Ave Bypass | | Utilize existing storm sewer system along Leahi Ave as a bypass for Ala Wai Canal waters; Outfall is away from the highly traveled beach and tourist area; Existing outfall near Tahitienne Condos of Honolulu | Under consideration - Tier 2 | This measure will be modeled once a more accurate assessment of water flows is determined after Tier 1 measures are modeled. |
| 192 | H1 Underground Storage System | | Series of underground detention basins along the H1 highway | Under consideration | |
| 193 | Ala Wai Canal Floodwall System | | Series of floodwalls on the left and right banks of the Ala Wai canal and M-P canal; includes road closure structures and access for the canoes; deployable/passive system or glass system to keep viewshed | Under consideration - Tier 2 | This measure will be modeled once a more accurate assessment of water flows is determined after Tier 1 measures are modeled. |
| 194 | Manoa-Palolo Diversion Structure | | Diversion structure downstream of the Date Street bridge that diverts flows for a design storm to the Ala Wai Golf Course; In combination with berms around the golf course to increase storage. | Under consideration | |
| 195 | Ala Wai Golf Course Berm | | Berms in strategic locations to increase above-ground flood storage; can be used in combination with diversion structure | Under consideration - Tier 1 | See notes on measure 39. |
| 196 | Ala Wai Canal Surge Barrier | | Surge barrier/Flood gates to reduce impacts from tide and increase storage in canal; pump station in conjunction with floodwalls along canal to increase storage capacity | Under consideration | |
| 197 | Ala Wai Canal Pump Station(s) | | System of smaller pumps along the canal to reduce standing water or used in conjunction with floodwalls/berms to increase storage capacity | Under consideration | |

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| 198 | Ala Wai Canal Deepening | | Dredge canal to an appropriate depth to increase storage capacity and maintain slope/structural integrity | Screened Out | Dredging to the maintenance elevation is encouraged for the City to maintain consistently. Deepening the canal further than the maintenance elevation is generally not recommended due to the stability of canal walls and slope stability. Increasing storage of the canal can technically reduce flooding but not without instability of the structural components of the bridges and canal walls. The integrity of the canal walls as-is would not withstand excavation - only replacing with an entirely new system would. Further analysis is needed to determine the stability of bridge pier and footings. |
| 199 | Cool Ala Wai | | Plan includes forest restoration in upper watershed; converting golf course to wetlands on the lower 2/3 and residential housing on the upper 1/3; gate structures at the golf course inlet and Manoa-Palolo to control the flow of water into the canal; gate structure at mouth of canal to address sea level rise and storm surge; mimic the Singapore Marina Barrage for urban reservoir design, https://www.youtube.com/watch?v=4WA2sR6pBRo | Screened Out | Individual components of this plan have been addressed in other measures within this spreadsheet. See measures #65 and #109 for forest management, #39 for wetlands, #194 for diversion structure at the golf course, and #196 for gate structure at the mouth. Measures that were not individually screened from additional consideration will be evaluated further.<br><br>Rezoning residential housing is outside the scope of this project. |
| 200 | Portable flood barriers | | Portable flood barriers, https://www.youtube.com/watch?v=dQjqFPKh01s | Under consideration | |
| 201 | Palolo diversion channel | Palolo | The water from the Palolo Valley should go straight into the Ocean parallel to Kapahulu Avenue and be decoupled from the Manoa-Palolo Canal (that is a major old design mistake that exacerbates the current risk of flooding). | Under consideration | See measure 66 |
| 202 | Ala Wai Green | Ala Wai Golf Course | A bio-diverse, multi-function natural resource park. The Ala Wai Green would occupy the ewa 2/3 of the closed golf course. Restore the former wetlands and serve as a natural retention basin for the collection of rainwater from the valleys in a complex of reservoirs, ponds, and waterways. Debris, soil runoff and pollutants from upstream would be removed after passing through a series of gates and a multi-stage filtration system before entering into the Ala Wai canal. | Under consideration | See measure 39. |
| 203 | Overflow ditches parallel to the Ala Wai Canal | Ala Wai Canal | Construct overflow ditches parallel to the Ala Wai Canal (see diagram) on the Mauka (Mountain) side. Within the ditch, construct water jets at the bottom and sensors along the walls of the ditch. A grill would cover the ditch for safety and some sort of screen to prevent debris from falling into the ditch. Prior to the storm, screens would be removed to allow maximum over flow water to enter the ditches. | Under consideration | |
| 204 | Filter Strips | Ala Wai Canal | Filter strips that reduce erosion and nitrate contaminates for high rainfall event. (Potentially use Kernza plant) | Screened Out | Best management practices, such as filter strips, to reduce runoff and improve water quality are outside the USACE study authority. |